

**CLAIMS**

What is claimed is:

- 5 1. A method for operating a virtual machine within a data processing system, the method comprising the computer-implemented steps of:
  - storing an object in memory that is managed by a virtual machine that is running on a device within the data processing system;
  - 10 associating the object with a plurality of objects within an object group;
  - associating the object group with the virtual machine, wherein the virtual machine incorporates functionality for interoperating with other virtual machines in a virtual machine cluster, and wherein each virtual machine in the virtual machine cluster acts as a node within the virtual machine cluster;
  - 15 managing a plurality of object groups within each virtual machine of the virtual machine cluster; and
  - 20 allowing the object group to be moved from the virtual machine to a different virtual machine in the virtual machine cluster.

2. The method of claim 1 further comprising:  
disassociating the object group from the virtual  
machine;  
moving the object group to the different virtual  
5 machine in the virtual machine cluster; and  
in response to moving the object group to the  
different virtual machine, associating the object group  
with the different virtual machine.
- 10 3. The method of claim 1 further comprising:  
sharing information about locations of a plurality  
of object groups with each virtual machine in the virtual  
machine cluster.
- 15 4. The method of claim 1 further comprising:  
associating the object group and a different object  
group with a thread managed by the virtual machine.
5. The method of claim 4 further comprising:  
20 storing the object group and the different object  
group in a thread local heap associated with the thread.
6. The method of claim 4 further comprising:  
storing the object group in a first thread local  
25 heap associated with the thread; and  
storing the different object group in a second  
thread local heap associated with the thread.

7. The method of claim 4 further comprising:  
disassociating the object group from the thread;  
terminating the thread; and  
in response to termination of the thread, managing  
5 the object group without an association between the  
object group and a thread managed by the virtual machine.
8. The method of claim 1 further comprising:  
creating an object handle for the object that is  
10 independent of a location of the object.
9. The method of claim 8 further comprising:  
generating an object handle for the object;  
storing in the object handle a group identifier for  
15 the object group with which the object is associated,  
wherein the group identifier is unique within the virtual  
machine cluster; and  
storing in the object handle an object identifier  
for the object, wherein the object identifier is unique  
20 within the object group with which the object is  
associated.
10. The method of claim 1 further comprising:  
creating an object reference for the object that is  
25 independent of a location of the object and that is  
independent of a location of the object group with which  
the object is associated.

11. The method of claim 1 further comprising:
- creating a first object reference for the object while the object is located on the virtual machine;
  - moving the object group with which the object is associated to the different virtual machine; and
  - creating a second object reference for the object while the object is located on the different virtual machine, wherein the first object reference and the second object reference are identical.

12. A computer program product on a computer readable medium for use in a data processing system for operating a virtual machine, the computer program product comprising:

5       means for storing an object in memory that is managed by a virtual machine that is running on a device within the data processing system;

          means for associating the object with a plurality of objects within an object group;

10       means for associating the object group with the virtual machine, wherein the virtual machine incorporates functionality for interoperating with other virtual machines in a virtual machine cluster, and wherein each virtual machine in the virtual machine cluster acts as a  
15   node within the virtual machine cluster;

          means for managing a plurality of object groups within each virtual machine of the virtual machine cluster; and

          means for allowing the object group to be moved from  
20   the virtual machine to a different virtual machine in the virtual machine cluster.

13. The computer program product of claim 12 further comprising:

25       means for disassociating the object group from the virtual machine;

          means for moving the object group to the different virtual machine in the virtual machine cluster; and

          means for associating the object group with the  
30   different virtual machine in response to moving the object group to the different virtual machine.

14. The computer program product of claim 12 further comprising:

5 means for sharing information about locations of a plurality of object groups with each virtual machine in the virtual machine cluster.

15. The computer program product of claim 12 further comprising:

10 means for associating the object group and a different object group with a thread managed by the virtual machine.

16. The computer program product of claim 15 further comprising:

means for storing the object group and the different object group in a thread local heap associated with the thread.

20 17. The computer program product of claim 15 further comprising:

means for storing the object group in a first thread local heap associated with the thread; and

25 means for storing the different object group in a second thread local heap associated with the thread.

18. The computer program product of claim 15 further comprising:

means for disassociating the object group from the thread;

5 means for terminating the thread; and

means for managing the object group without an association between the object group and a thread managed by the virtual machine in response to termination of the thread.

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19. The computer program product of claim 12 further comprising:

means for creating an object handle for the object that is independent of a location of the object.

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20. The computer program product of claim 19 further comprising:

means for generating an object handle for the object;

20 means for storing in the object handle a group identifier for the object group with which the object is associated, wherein the group identifier is unique within the virtual machine cluster; and

25 means for storing in the object handle an object identifier for the object, wherein the object identifier is unique within the object group with which the object is associated.

21. The computer program product of claim 12 further comprising:

means for creating an object reference for the object that is independent of a location of the object  
5 and that is independent of a location of the object group with which the object is associated.

22. The computer program product of claim 12 further comprising:

10 means for creating a first object reference for the object while the object is located on the virtual machine;

means for moving the object group with which the object is associated to the different virtual machine;

15 and

means for creating a second object reference for the object while the object is located on the different virtual machine, wherein the first object reference and the second object reference are identical.



23. An apparatus in a data processing system for operating a virtual machine, the apparatus comprising:

means for storing an object in memory that is managed by a virtual machine that is running on a device  
5 within the data processing system;

means for associating the object with a plurality of objects within an object group;

means for associating the object group with the virtual machine, wherein the virtual machine incorporates  
10 functionality for interoperating with other virtual machines in a virtual machine cluster, and wherein each virtual machine in the virtual machine cluster acts as a node within the virtual machine cluster;

means for managing a plurality of object groups  
15 within each virtual machine of the virtual machine cluster; and

means for allowing the object group to be moved from the virtual machine to a different virtual machine in the virtual machine cluster.

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24. The apparatus of claim 23 further comprising:

means for disassociating the object group from the virtual machine;

means for moving the object group to the different  
25 virtual machine in the virtual machine cluster; and

means for associating the object group with the different virtual machine in response to moving the object group to the different virtual machine.

25. The apparatus of claim 23 further comprising:  
means for sharing information about locations of a plurality of object groups with each virtual machine in the virtual machine cluster.

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26. The apparatus of claim 23 further comprising:  
means for associating the object group and a different object group with a thread managed by the virtual machine.

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27. The apparatus of claim 26 further comprising:  
means for storing the object group and the different object group in a thread local heap associated with the thread.

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28. The apparatus of claim 26 further comprising:  
means for storing the object group in a first thread local heap associated with the thread; and  
means for storing the different object group in a second thread local heap associated with the thread.

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29. The apparatus of claim 26 further comprising:  
means for disassociating the object group from the thread;

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means for terminating the thread; and  
means for managing the object group without an association between the object group and a thread managed by the virtual machine in response to termination of the thread.

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30. The apparatus of claim 23 further comprising:  
means for creating an object handle for the object  
that is independent of a location of the object.

5 31. The apparatus of claim 30 further comprising:  
means for generating an object handle for the  
object;  
means for storing in the object handle a group  
identifier for the object group with which the object is  
10 associated, wherein the group identifier is unique within  
the virtual machine cluster; and  
means for storing in the object handle an object  
identifier for the object, wherein the object identifier  
is unique within the object group with which the object  
15 is associated.

32. The apparatus of claim 23 further comprising:  
means for creating an object reference for the  
object that is independent of a location of the object  
20 and that is independent of a location of the object group  
with which the object is associated.

33. The apparatus of claim 23 further comprising:  
means for creating a first object reference for the  
object while the object is located on the virtual  
machine;

5 means for moving the object group with which the  
object is associated to the different virtual machine;  
and

means for creating a second object reference for the  
object while the object is located on the different  
10 virtual machine, wherein the first object reference and  
the second object reference are identical.